tions of most of these earlier species and none of them show the characteristic ovary of *B. dolichocarpa.*

BOTANY.—*A new species of* Hymenophyllum *from Peru.*[1] C. V. MORTON, U. S. National Museum. (Communicated by WILLIAM R. MAXON).

Mr. C. Bües, of Quillabamba, Peru, has collected many very interesting Peruvian ferns. A considerable number of these have been received by the U. S. National Museum through the kindness of Professor Fortunato L. Herrera, of the University of Cuzco. Included in the collection is a remarkable species of *Hymenophyllum*, here described as new.

Hymenophyllum amabile Morton, sp. nov.
Fig. 1

Euhymenophyllym; rhizoma longe repens parce ramosum fuscum 0.5 mm. diametro, pilis furcatis flavidis flaccidis pluricellularibus instructum, radicibus numerosis; stipites 2.5–6 cm. longi, 0.5 mm. diametro, teretes nec alati nigri nitidi dense pubescentes, pilis fuscescentibus stellatis stipitatis, demum glabrata; rhachis recta, teres, haud alata, 0.5 mm. diametro, pilis densissimis eis stipitis similibus; laminae pendulae lineares, 21–35 cm. longae, 3–4 cm. latae, pinnatae, pinnis pinnatipartitis; pinnae ovatae vel oblongae, maximae 2.5 cm. longae et 1.5 cm. latae, apicem versus gradatim reductae, sessiles, paullo decurrentes, haud surcurrentes, margine venisque densissime griseo-ferrugineo-pubescentes, pilis stipitatis ramis numerosis stellatis, rhachibus venisque vix flexuosis nigris; lamellae desunt; segmenta inferiora pinnatipartita, superiora semel furcata vel integra; segmenta ultima oblonga, maxima 4 mm. longa, omnia ca. 1 mm. lata, obtusa nec emarginata, nervis apicem non attingentibus, simplicia vel semel furcata; sori in lobulis extremis haud abbreviatis terminales; indusium non immersum, ad basin bilobum, lobis transverse ovalibus, ca. 0.6 mm. altum, 1 mm. latum, tenuissime membranaceum, fragile, margine integrum, extus densissime pubescens et ciliatum, pilis stellatis; sporangia numerosa in apicibus capitatis receptaculorum.

Type in the U. S. National Herbarium, no. 1,515,445, collected at Michihuañuncca, Huadquiña, Prov. de la Convención, Dept. Cuzco, Peru, alt. 3,000 meters, December, 1920, by C. Bües (no. 715).

Hymenophyllum amabile belongs to the *H. sericeum* group of species. It is distinguished at once from that species and its relatives *H. tomentosum, H. pyramidatum, H. lobato-alatum, H. fusugasugense,* and *H. plumosum* by the absence of wings on the secondary rhachises and veins. The remaining species of the group are *H. pulchellum, H. karstenianum, H. chrysothrix, H. spectabile, H. refrondescens, H. speciosum, H. buchtienii, H. elegantulum, H. sprucei, H. trichophyllum,* and *H. interruptum.* The last four named are

[1] Published by permission of the Secretary of the Smithsonian Institution. Received December 24, 1931.

Fig. 1. *Hymenophyllum amabile* Morton, type specimen. Slightly less than one half natural size.

quite unrelated to the present species. The close, fine pubescence of *H. karstenianum*, *H. spectabile*, and *H. speciosum*, in which the individual hairs are not apparent except under magnification, is very different from the coarse pubescence of *H. amabile*, in which the individual hairs are prominent. All three of these species differ from ours also in their elongate, acuminate (rather than ovate or oblong, obtuse) pinnae. *H. buchtienii* Rosenst. and *H. pulchellum* C. & S. have pubsecence somewhat similar to the present species, but the hairs are less coarse and are sessile or only short-stipitate, in contrast to those of *H. amabile* which are long-stipitate. *H. buchtienii* (from Bolivia) is moreover a much smaller and more delicate plant with non-decurrent pinnae. *H. pulchellum* has a very different range (Mexico) and differs in several particulars from the present species, especially in its smaller size and less divided, petiolate (rather than sessile) pinnae. *H. refrondescens* Sod., of Ecuador, differs conspicuously in its alate rhachises and adnate pinnae; it is known to me from description only. *H. amabile* has terete non-alate rhachises and nearly free pinnae, i.e. not at all surcurrent and only slightly decurrent. *Hymenophyllum chrysothrix* Sturm, a little known species of Venezuela and Brazil, is perhaps most closely related, differing in its finer, less dense pubescence, broadly lanceolate (rather than linear) blade, petiolate (not at all decurrent) pinnae, and subimmersed indusia. The indusium of *H. amabile* is not at all immersed in the leaf tissue.

ZOOLOGY.—*Spawning reactions of three species of oysters.*[1] PAUL S. GALTSOFF, U. S. Bureau of Fisheries.

Since 1927 the author has been engaged in a study of the factors that control the shedding of eggs and sperm of the eastern oyster, *Ostrea virginica*. In 1929 the opportunity presented itself to experiment with the Japanese oyster, *O. gigas*, grown in Puget Sound, and during the summer of 1930 several experiments were carried out with the Australian oyster, *O. cucullata*, and *O. virginica* grown in the waters near Honolulu, T. H. A complete report of these investigations comprising nearly four hundred experiments will be published in the Bulletin of the Bureau of Fisheries.

The technique employed in all the experiments consisted in placing the oyster in a tank of about 20 or 30 liter capacity, in which the water was aerated, stirred and kept at constant temperature. In the majority of the experiments the thermo-regulators were set at 22.5°C. and they maintained this temperature within 0.5°C. The oyster was immobilized with plaster of Paris and one of its valves was attached to a light kymograph lever made of a strip of celluloid. It has been shown

[1] Published by permission of the U. S. Commissioner of Fisheries. Received January 5, 1932.

in a previous paper[2] that spawning of the female oyster consists of a series of the following reactions: contractions of the mantle, rhythmical contractions of the adductor muscle, and discharge of eggs. Rhythmical contractions of the muscle enable one to obtain a permanent record which can be easily analyzed. The results of a large number of experiments with *O. virginica* carried in 1927–1929 show that no spawning occurs below 20.0°C., whereas the same specimen reacts to the same suspension of sperm as soon as the temperature has been brought above 20.0°. In a few instances it has been noticed that oysters spawned at 27.5° without being stimulated by sperm. Inasmuch as in those cases unfiltered water was used the possibility of its contamination with sperm was not excluded. In the experiments with *O. gigas* it has been found that a ripe female oyster can be induced to spawn by a temperature of 30.0°C. The question naturally arises whether the same results could not be obtained with the other species. During the summer of 1931 experiments were carried out at Woods Hole with ripe oysters which were kept in aquaria at a temperature of about 20.0°C. To avoid possible contamination the water used in the experiments was filtered through a layer of asbestos about three quarters of an inch thick. The results of the experiments, summarized in Table 1, indicate without any doubt that ripe females can be induced to spawn by placing them in water having a temperature from 24.5° to 30.0°C. At 31.0°C. the females usually close their valves and remain closed until the temperature drops to 30° or 29°.

The latent periods of spawning reactions, i.e. the time elapsed from the moment the oyster was exposed to a given temperature until the beginning of spawning, varies from 22 to 257 minutes and apparently is not correlated with the temperature, the quickness of the response probably depending on the conditions of the organism itself. In a series of other experiments which can not be described in a brief article, the females which failed to respond to high temperature (26°–30°C.) readily responded to the addition of sperm. In all the experiments recorded in Table 1 the eggs discharged by the oysters were unfertilized and did not develop. The fact that the females can be stimulated by a temperature of 24.5° or higher suggested the possibility that a similar effect might be obtained by a longer exposure to temperatures between 20.0° and 24.5°C. The results of a long number of experiments, of which only three will be here described,

[2] Proc. Nat. Acad. Sci. **16**: 555–559. 1930.

show that this is very doubtful. On July 10 three ripe females were taken from the tank, in which the temperature during the previous week fluctuated between 18.5° and 19.5°C., and placed in an aquarium filled with filtered sea water. The temperature was kept at 22.6°C. but occasionally rose to 23.4°C. The shell movement of each oyster was recorded on the kymograph. The first oyster was kept for 5 hours 22 minutes, the second for 29 hours 53 minutes, and the third one for 73 hours 13 minutes. The water in the tanks in which the second and third oysters were kept was changed twice a day. None of the oysters spawned during that time but each of them spawned after sperm was added to the water the latent periods being 16, 24 and 15 minutes respectively.

TABLE 1.—Spawning Reactions of the Females of O. virginica Induced by Temperature

Date in 1931	Experiment No.	Temperature °C.		Latent period in minutes	Duration of spawning in minutes
		Before experiment	During experiment		
July 10	325	19.5	24.5	65	43
9	321	19.9	25.0	22	118
7	317	19.9	25.3	250	46
9	322	19.9	26.0	257	38
8	318	19.9	28.0	32	25
8	319	19.9	28.5	55	44
17	340	20.4	30.0	20	?
8	320	19.9	30.0	42	52

It is interesting to note that in both cases of stimulation either by the temperature or by the sperm the reaction is alike and is characterized by a series of rhythmical contractions of the adductor muscle and of the mantle. From that an inference can be made that both factors release some mechanism in the organism of the female which in turn stimulates the adductor muscle and causes the discharge of eggs from the ovary. In this respect the reaction is not specific. It is, however, specific in the sense that sperm of other mollusks (*Mya* spp., *Mytilus* spp.) fail to induce spawning of the oyster. No positive results were obtained also when the sperm of *O. cucullata* was added to the female of *O. virginica* and vice versa. The last experiments are not conclusive, however, because of the failure of the specimens used in the experiments to spawn immediately upon the addition of the sperm of the same species. A few days later the shedding of eggs was successfully